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ABSTRACT

Current theorizing in education, as in industry, is largely devoted to explaining trial-and-error, failure-tolerant, low-reliability organizations. This article examines changing societal demands on education and argues that effective responses to those demands require new and different organizational structures. Schools must abandon industrial efficiency models and assume the following operating characteristics of high reliability organizations (HROs), which: (1) require clear goals; (2) extend formal, logical decision analysis, based on standard operating procedures (SOPs), to the limits of extant knowledge; (3) recruit and train extensively to compel adherence to SOPs; (4) take initiatives identifying flaws in SOPs and nominate changes to correct them; (5) are sensitive to areas requiring judgment-based, incremental strategies; (6) feature mutual monitoring by administrators and line staff; (7) are alert to surprises and lapses; (8) are hierarchically structured, but allow considerable discretion and close interdependence during times of peak activity; (9) are not rule-driven when responding to potentially disastrous situations; (10) maintain equipment in highest working order; (11) are valued by their supervising organizations; and (12) value high reliability over short-term efficiency. For schools to become HROs would involve substantial changes. Links with HRO literature and school effects research are discussed, along with implications of HRO findings for policy, future research, and school improvement. (43 references) (MLH)

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Research on High Reliability Organizations: Implications for School Effects Research, Policy, and Educational Practice

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Abstract

This article examines changes in societal demands on education and argues that effective responses to those demands require new and different organizational structures. That new framework is the emerging research area known as High Reliability Organizations (HROs). The article presents characteristics of HROs and evidence from school effects studies which suggest that level of cross-class and cross-year reliability is an important dimension on which current school effects research differentiates more and less effective schools. Implications for educational policy, future research, and school improvement practice are discussed.

Research on High Reliability Organizations: Implications for School Effects Research, Policy, and Educational Practice

Through most of the 20th century, industrialized nations have provided universal educational opportunity to children. This has meant that all young people have been provided with at least some minimal set of schooling *services*. These service rights have included specified numbers of hours per day and days per year of seat time in front of teachers possessing at least minimal credentials. To varying degrees, states and nations have specified particular curricula, and if a child did not master the curricula he or she risked being "held back" a year or two. The responsibility for student growth was assumed to rest with the student and, perhaps, the student's family. The success of schools was not judged by the success of students. Research by Coleman et al. (1966) and others, which indicated that schools did not make a significant difference in students' learning, became part of the justification many first world school systems referenced in remaining unaccountable for student outcomes.

In the U.S. today, in Japan in the late 1940s, and in other nations in between a fundamental shift in the societal demands made of schooling is occurring or has already occurred. Schools are now held accountable for students' academic progress. The bases of the shift are often economic, occasionally scientific, and frequently political.

The cornerstone of raised demands is economic. U.S. states offer free, universal public schooling through grade 12 (age 18-19). The original logic of this offering was religious: It was believed that young people needed to learn to read the Bible for the good of their souls. Over time the logic became economic: Industries required increased numbers of workers with skills in reading and mathematics. Public education remained optional above age 12-16 (depending on the state) in part because many functions in the

society required minimal education and paid reasonably well. For example, in the mid-1980s the average U.S. automobile assembly line bolt-tightener made over \$26 per hour.

Several aspects of the U.S. economic landscape have changed. The U.S. economy is no longer generating well paid blue collar jobs. The gap in incomes among college graduates, high school graduates, and high school drop-outs has widened dramatically since the 1970s (Murphy & Welch, 1989). The author visited Detroit automobile production facilities in 1986, and the youngest blue-collar worker seen was over 30 years old; many workers were over 50. The number of cars made in Detroit has decreased one-third since then and seniority-based layoffs have continued. Pittsburgh, Pa., once the steel capital of the world, no longer has a single large capacity steel mill. The current generation of young non-college graduates have either accepted lower paid service sector jobs, or are unemployed, or are in prison. Low paid jobs contribute little to the tax base, and unemployed people make demands on the public coffers. It costs more per year to keep a person in prison than to send him or her to Harvard, with prison providing much lower likelihood of return on society's investment. The implications of dropping out of school for citizens' personal fulfillment and for the tax base are increasingly severe.

The issues involved in raising the achievement and attendance levels of the majority of students are not concerned with "can it be done?" Many "lighthouse" schools and school effects studies have clearly demonstrated the potential for schools to assist students in obtaining higher achievement. By analogy, in the management of air traffic over major airports, the issue is not whether planes can take off and land safely; it is well known that modern aircraft can achieve those goals. The issues societies are currently facing concern the *reliability* with which air traffic can be managed, and the reliability with which schools can facilitate all students' academic progress toward high school graduation.

The facts that we have now demonstrated that airplanes can take off safely and that poor children can learn are considerable credits to our culture. In the case of education, the fact that our issues now concern reliability have implications research, policy and practice.

In the next section of this paper, research findings on general characteristics of high reliability organizations, all of which comes from non-educational institutions, will be presented. After each characteristic, relevant research from school effects and related research and practice will be compared with the non-educational data. This will lead to a general discussion of the implications of this field for future research and practice in education.

High Reliability Organizations

Imagine visiting an organization which has the following general characteristics: widespread evidence of low employee morale and ongoing labor-management conflicts which are contributing to carelessness. There have been staff reductions which were perceived as having directly contributed to a rise in accidents and an eroded emergency human back-up capability. Workers have inadequate training and staff development. Management and staff have little information regarding the potential short- and long-term hazards of not doing their jobs well. Management has failed to investigate the causes of previous poor performance, and staff are not carrying out several crucial tasks of the facility. Back-up and support systems are either non-operational or of such poor quality as to be irrelevant. The central administration of the larger system views the facility as having low importance. Equipment and materials sent to the building are often sub-standard.

The author has visited schools which fit this description in rural and ghetto America. Several such schools were negative outliers in the Louisiana School Effectiveness Study (LSES) (Stringfield & Teddlie, 1991). However, the above description is of Union Carbide's now infamous chemical plant at Bhopal, India, site of the worst industrial accident in the history of the free world (Shrivastava, 1986).

The tragedy at Bhopal served as a warning to industry, and the negative outliers of school effectiveness studies may provide similarly useful information to school administrators. What has happened in some industries is a recognition that in some areas

of modern culture, institutions and technologies have emerged which have great productive as well as destructive powers. Quoting LaPorte and Consolini (1991): "Increasingly, any failure of these technologies is perceived by both their operators and the public to have such potentially grave consequences as to warrant the absolute avoidance of failure" (p. 19).

Note that the issue is not whether the technology can generally function correctly; that is a given. Rather, the requirement is that the technology will virtually never malfunction. The issue is not validity, but extraordinarily high reliability.

In several areas deemed critical to the public interest such as the operation of nuclear electrical plants and aircraft control towers, new types of organizational structures have evolved to meet the requirements of virtual 100% reliability. These organizations are required to engage not in trial and error improvement, as is most common in both industry and the management literature. Rather, the organizations are expected to operate "*trials without errors*" (LaPorte and Consolini, 1991, p. 20). Researchers investigating the characteristics of these systems have referred to them as "High Reliability Organizations (HROs)" (Roberts, 1990.)

Current theorizing in education, like that in industry, is largely devoted to explaining trial-and-error, failure-tolerant, low-reliability organizations. This has been appropriate for the industries and schools of the past. However, the current generation of demands placed on education, such as the high goals stated in U.S. President Bush's "America 2000" proposal, are, at heart, that the overwhelming majority of students must succeed in school, that schools must operate trials without errors (or with unprecedentedly low error rates). This is a demand which is novel in the history U.S. education.

It is no longer economically or politically acceptable for significant numbers of students to not learn "the basics," or for *most* students to learn them well. It is no longer acceptable for large numbers of students to drop out of school. The costs to individuals and to society, once low, have become too high. Schools are no longer afforded the luxury of blaming the students and their families for students' failures. Schools are now seen as

accountable for the successes and failures of *virtually all* of their students. In order to respond to these new realities, schools will have to abandon industrial efficiency models and take on the operating characteristics of HROs.

The following pages present an overview of the primary characteristics of HROs (adapted from Pfeiffer, 1989; Roberts, 1990; and LaPorte & Consolini, 1991). Each characteristic is followed by this author's impressions of current U.S. education on these dimensions.

1. *HRO's require clarity regarding goals. Staff in HROs have a strong sense of their primary mission.*

Establishing and maintaining clear goals has been one of the most frequently cited characteristics of the school effects research base (Edmonds, 1979; Good & Brophy, 1986; Levine & Lezotte, 1990.) Stringfield and Teddlie (1988, 1991) found that a cacophony of "most important" goals often resulted in no clear, unifying goals for the faculties and students in low achieving schools.

Unlike most other first world nations, the U.S. has historically chosen to decentralize goal setting. However, the "America 2000" goals (U.S. Department of Education, 1991) are a clear reversal of this historical tendency. Such goals as all students entering first grade ready to learn, reducing the high School drop-out rate by over 50%, and raising the mathematics and science achievements of all students to very high levels have all been achieved in a few U.S. schools. Seriously holding those goals for *all* U.S. schools is a novel idea.

2. *HROs extend formal, logical decision analysis, based on standard operating procedures (SOPs), as far as extant knowledge allows.*

At the time of the publication of the first *Handbook of Research on Teaching* (Gage, 1963), there was not a sufficient body of educational research to rationally guide the

development of standard operating procedures for schooling. In the absence of such knowledge, and in the absence of clear national or state goals, districts developed local procedures. Districts, local superintendents, and principals often abdicated these responsibilities to teachers, with virtually no monitoring of resulting practice. By the third edition of the *Handbook* (Wittrock, 1986) the research situation had changed considerably. The rudiments of a science of education now exist. Practice has been slow to follow.

An important link between school effects research and HRO literature is provided by two studies of teachers' behavior in more and less effective schools. Both Mortimore et al. (1988) and Teddlie et al. (1989) found that teachers in high outlier schools behaved in manners more like those predicted by the teacher effects literature (Brophy & Good, 1986). Perhaps as important, both the Mortimore et al. and the Teddlie et al. studies found greater *consistency* among teachers in more effective schools. More teachers were more likely to be moving students through their lessons at a good pace, and fewer teachers allowed high rates of time off task. Stringfield and Teddlie (1991) found that this higher consistency on the part of teachers was clearly related to the behaviors of the principals.

3. *HROs recruit and train extensively in order to compel adherence to SOPs.*

There is very little research on teacher, principal, and superintendent recruitment, and essentially none on the "effects" of recruitment. (For an initial effort which deserves multiple replications, see Wise et al., 1987.) Research on the "how to" of effective training has made much greater progress (Showers, Joyce & Bennett, 1987; Lewis & Miles, 1990; Fullan, 1991.) Ward and Tikunoff (1989) and Kirby et al. (1991) have recently conducted detailed studies of teacher induction programs, and both studies found school level effects. However, much research on the long term effects of various induction and staff development programs has yet to be conducted.

Stringfield and Teddlie (1991) found that principals in positive outlier schools were more likely to take an intense interest in staff recruitment. By contrast, principals in low outlier schools often reported that all personnel decisions were beyond their control.

4. *HROs have initiatives which identify flaws in SOPs and nominate and validate changes in those that prove inadequate.*

The author is unaware of large-scale research on school or district level systematic, organizational efforts to identify flaws within schools and correct them. However, Mortimore et al. (1988) and Stringfield and Teddlie (1991) described principal and staff actions in more effective schools that might serve to identify problems within schools and facilitate correction. Stringfield and Yoder (1992) present a case study of an exemplary school serving highly disadvantaged children. That school consistently developed standard operating procedures and with equal frequency sought out methods for improving those procedures.

The 1988 Hawkins-Stafford Amendments to the U.S. compensatory education law mandate a self-study and "program improvement" process for schools in which compensatory education students are not making adequate academic gains (LeTendre, 1991). Thousands of schools have been identified nationwide (Heid, 1991), and in several states those schools enter into an extended self study with the eventual goal of school-directed improvement (see Stringfield, Davis, & Billig, 1991).

However, it is probably safe to say that the typical U.S. teacher does not view herself as having open access to processes which could change significant school and district procedures.

5. *HROs are sensitive to the areas in which judgement-based, incremental strategies are required. They, therefore, pay considerable attention to performance, evaluation, and analysis to improve the processes of the organizations.*

U.S. education is currently undergoing increased emphasis on performance-based evaluation of teachers (ex., Millman (1981, 1989). Bridges (1986) has conducted a scholarly and commonsensical analysis of procedures for managing incompetent teachers. Bridges' work demonstrates that effective action is possible, though rarely undertaken. The author concedes the majority of incompetent teachers are allowed to continue intervening in the educational lives of children. Obviously, this detracts from schools' reliability.

Stringfield and Teddlie (1991) reported that principals in the more effective schools took teacher recruitment, development, and evaluation more seriously than did principals in the study's negative outlier schools. Most of the principals in the positive outlier schools had counseled out, forced the transfer, or otherwise removed one or more teachers from their staffs. That was rarely true of principals in negative outlier schools.

6. *Monitoring is mutual (administrators and line staff) without counterproductive loss of overall autonomy and confidence.*

In the U.S. there is currently minimal evaluation of teachers by administrators or fellow teachers, and virtually no evaluation of administrators by teachers. Mutual monitoring is a distant dream.

7. *HROs are alert to surprises or lapses. The experience of HROs is that small failures can cascade into major system failures, and are hence monitored carefully.*

The author is unaware of studies focused specifically on schools' responses to surprises or lapses. It is easy to imagine that Mortimore et al.'s (1988) "purposeful leadership," "maximum communication between teachers and students," and "record keeping"—all found to be characteristics of more effective schools—would lead to quicker response to surprises or lapses. Similarly, Stringfield and Slavin's (1991) "attention to

daily academic functioning" as a school-level predictor of school effects might lead to quicker discovery of and response to lapses.

The concept of small failures cascading into, for example, students remaining illiterate and eventually dropping out of school is one deserving of much more attention. Lloyd (1978) found that a student being held back once in grades 1-3 is very likely to drop out of high school 6-11 years later. Small instructional failures which were almost certainly preventable or even reversible if addressed in primary grades regularly cascade into students' choosing to drop out. Increasingly, first world societies are viewing students dropping out as constituting failures of a powerful technology.

8. *HROs are highly hierarchically structured, but during times of peak loads, HROs emphasize a second layer of behavior which emphasizes collegial decision making regardless of rank. This second mode is characterized by cooperation and coordination. At times of peak activity, line staff are expected to exercise considerable discretion.*

U.S. schools are hierarchically structured. An instructional aide openly disagrees with a teacher's diagnosis of a student's needs only at the risk of unemployment. Successful teacher rebellions against principals are very rare. A principal who repeatedly disagrees with his or her superintendent is typically surrendering any chance of advancement.

Expectations during schools' "peak" times have not been systematically studied, but probably vary greatly. The author's impression is that during peak times at some schools, accommodations are made, everyone pitches in, and important functions continue to operate. By contrast, in some schools temporarily heavy loads become excuses for non-performance by key staff members.

9. *High Reliability Organizations regularly respond to potentially disastrous situations as being far too important to trust to rules alone. Authority patterns shift from hierarchical to functional-skill based authority, as needs arise.*

Large U.S. school districts generally, and "special education" programs in particular, are rule focused and rule driven. In some schools and districts, exceptions to rules are almost never tolerated. This is often to the short and long term detriment of individual children.

10. *Especially during times of peak performance, staff are able to assume a close interdependence. Relationships are complex, coupled, and sometimes urgent.*

A high level of coordination between compensatory and regular classrooms was found to be a characteristic of more effective compensatory education programs in the U.S. (Griswold, Cotton, & Hansen, 1985; Allington & Johnston, 1989). Mortimore et al. (1988) found that involvement of teachers in decision making, and consistency among teachers in service provision were both related to school effectiveness. Stringfield and Teddlie (1991) also reported that high levels of cross-classroom and cross-grade coordination were positive predictors of school effects.

The majority of U.S. educational theorists view American schools as being "loosely coupled." Murphy (1989) has argued that U.S. schools became more tightly coupled during the 1990s. But neither theoreticians nor researchers have made distinctions between regular and peak performance times.

11. *Equipment is maintained and kept in the highest working order. Responsibility for checking the readiness of key equipment is shared equally by all who come in contact with it.*

This is not true in most U.S. schools, where non-functioning equipment often sits unrepaired for months or years. A striking feature of equipment maintenance in many

schools is the extent to which unnamed persons beyond the school are viewed as being responsible for maintenance. This situation may in part be a result of many educational administrators viewing no equipment, beyond heaters and an office telephone, as "key."

12. HROs are invariably valued by their supervising organizations.

There is some evidence (e.g., Wimpelberg et al., 1989), that school districts provide more attention and support to some schools than others, and that it is often the schools in the least advantaged neighborhoods that receive the least attention and local support. Stringfield and Teddlie (1988) have observed that some school districts, rather than retraining or terminating manifestly unskilled teachers and principals, assign them to schools serving the least advantaged families in the districts. Such actions do not indicate high valuing of *all* students and schools by central office personnel.

As noted earlier, the accountability requirements of the Hawkins-Stafford Amendments of 1988 have led some U.S. districts to pay increased attention to the schools serving higher percentages of disadvantaged students. Winfield (1991) reported that in order to facilitate a shift to "schoolwide project" use of federal compensatory education funds, one large school district discontinued its practice of requiring some schools to accept the involuntary transfer of probationary teachers. This would appear to be evidence of increased valuing of the schools by central administration, as a result of changes in the law.

13. Short-term efficiency takes a back seat to very high reliability.

U.S. education has spent much of the last 30 years attempting to become more efficient, and much public dialogue concerns ridding education of "wasteful management."

Discussion

Schools are now being asked to do for virtually all children what they have historically done reasonably well for many children. Schools are being asked to achieve

virtual 100% high school level literacy in several subjects. This will require unprecedented levels of organizational reliability. The high reliability organization literature describes at least 13 characteristics of organizations which are required to operate trials without cascading errors.

Several school effects studies suggest linkages with the HRO literature; however, for a typical U.S. school to become an HRO, it would need to make major changes. Some of those changes would require support from above the school. Schools and administrators would need to clarify goals; create clear SOPs as regards curriculum, instruction, and the handling of various student and task management issues; greatly increase goal-directed staff development; further open access to rule making; improve two-way staff evaluation procedures and practices; be clearer and more flexible in dealing with situations in which special needs of children must be met (bureaucratic concerns must occasionally be subsumed under practical, extraordinary needs); the isolation of teachers would have to be replaced with more collegial working relationships; and finally a school would need to allocate funds not just to procuring new equipment, but to maintaining existing equipment.

The most important shift in considering HROs, however, would not be in the specific characteristics of the organizations, rather, it would be in the intellectual shift which must precede the evolution of the characteristics. The most important characteristic of HROs is *a perception, held by the public and the employees, that failures within the organization would be disastrous*. Bhopal was disastrous. Three Mile Island was very nearly disastrous. As the personal and macro economic rewards for learning to read and to perform higher order mathematical functions and for obtaining high school, college, and advanced degrees have increased (and the costs for persons not achieving have increased) the cascading failures of schooling are becoming much more expensive. Schools will come to more nearly resemble HROs as the public and

the professionals who operate the schools come to view individual children's not learning to read as constituting individual travesties and public disasters.

There is evidence that the public mandate to educators has changed. The new mandate, clearly expressed in "America 2000" and other policy documents, is that schools be responsible for high achievement levels from *all* students. Given that schools have previously demonstrated competence at educating many students, the critical issue is not how to educate some or any students. Rather, the new issue is one of much higher reliability of schooling.

To date, the field of school effectiveness research has focused much of its energy on identifying variables which explained differences between schools in which students scored higher or lower on achievement tests, attended school with greater or lesser regularity, and so on. The practical implications of this research were assumed to follow naturally: if researchers could determine what the best schools had, and give it to all schools, all students' achievement levels would rise.

Yet, even after the U.S. Congress's General Accounting Office (1989) found that over half of U.S. school districts are implementing "school effectiveness research," study after study has found that U.S. students are not showing significant gains in achievement (Educational Testing Service, 1991; General Accounting Office, 1990).

How can that be? The first policy-relevant assertion of this paper is that so long as schools attempt to respond to one or more specific "school effectiveness correlates" without building high reliability organizations at the classroom, school, and higher administration levels, those school restructuring efforts will continue to fail to produce the unprecedented levels of educational reliability being sought. If what is wanted is reliability—policy, research, and practice should strive directly for reliability.

A second implication can be stated as a testable hypothesis. It is that school restructuring efforts which focus scarce resources on a small, energetic cohort within any school on the *assumption* that other professionals will follow, will fail. For a passenger on

an airplane which is in a weather delay over London's Heathrow or Chicago's O'Hare airport, the question of how superb is the best air traffic controller in the tower is not very important. How poorly trained or distracted is the weakest monitor of an air sector through which the plane and several others are repeatedly passing may literally be a matter of life and death. For an organization to reach high reliability, *all* of its technological *and human* components must be maintained at a certain level. Raising the ceiling is pleasant and often attractive. Raising the floor is critical. School improvement efforts which ignore the understandable reasons for, and reality of, the floor will fail to raise the achievements of *all* students. "America 2000" and other public policy goals relate to virtually *all* students.

The high reliability organization literature offers support for some of the findings of previous school effects research. In particular, it supports the familiar characteristics of clear goals, attention to evaluations, and close coordination.

However, the HRO literature suggests several other areas which may be necessary for schools to serve all students well. Those areas clearly merit a great deal of further educational research and practical tests.. The development and maintenance of standard operating procedures where appropriate, greatly increased levels of targeted staff development, the importance of open lines of communication, mutual monitoring, alertness to surprises or lapses, and the maintenance of equipment may be important predictors of school effectiveness. Three areas suggested by HRO researchers seem particularly worthy of future research. These are differential behavior patterns during "peak load" times, clear evidence of valuing of schools by central offices, and the primacy of high reliability over short-term efficiency.

There is no systematic literature on the behavior patterns of educational professionals which contrasts very busy with more typical times. The HRO literature would predict that in times of stress, lower reliability schools would attempt to rely on established procedures while higher reliability schools would evolve more fluid responses. The area of "peak" times in schools deserves additional study.

Similarly, there is no systematic literature on the role of central offices in creating school effects. Wimpelberg (1989) makes a first approach at defining "a central role for the central office" and Fullan (1991) notes several features of districts and higher levels of government which facilitate innovation. The HRO literature would suggest that unless the central office places considerable value on the performance of students within *each* school, long term school effectiveness is unlikely.

The third area has clear implications for school financing. If schools are to become places of trials without errors, the HRO literature suggests they must be allowed to place reliability over short-term efficiency. In the U.S. the reverse has repeatedly been the case. School budgets have been allowed to increase during prosperous times, but have been cut during recessions. By contrast, the basic budgets of nuclear power plants are neither raised nor lowered with the economy. They are assumed to be too important to be cut to achieve short term efficiencies. Studies are needed on the effects of short term "efficiencies" or the short and long term achievement of students and morale of educational professionals.

If the first assertion of this article is correct—that schools are being increasingly counted on to produce virtually universal high rates of student achievement—if, in the words of LaPorte and Consolini (1991), "Increasingly, any failure of these technologies is perceived by both their operators and the public to have such potentially grave consequences as to warrant the absolute avoidance of failure" (p. 19), then over time all schools will be required to become HROs. Research on school effects now demonstrates some overlap with the noneducation-based HRO literature. Results of research on HROs may serve to guide future school effects studies.

More than one challenge to practical educators is suggested by the HRO literature. The history of educational reform has been one of new programs and new initiatives. In practice, these reforms have largely been cases of the most able experimenting with the "leading edge." The U.S. National Diffusion Network (1991), for example, has

disseminated descriptions of over 400 different "Programs That Work" (p. 7) for nearly 20 years.

The HRO literature suggests that efforts to improve coordination, staff development, and generally to improve or eliminate the weakest links in any school's educational chain may be more critical along the path to *all* students learning. It may prove more challenging to bring the "trailing edge" up to a suitable standard. Moreover, the "leading edge" technologies or programs may not be relevant until relatively high levels of staff competence and coordination are achieved.

A final policy-relevant conclusion concerns fiscal support for public schooling. HROs cost more than traditional industrial plants. They cost more because they are operating under different demands. Efficiency assumes a certain level of fault tolerance. The greater the tolerance for occasional failures, the greater the possible efficiencies. HROs are designed to achieve *trials without errors*. If the political rhetoric of "America 2000" and similar documents is to be taken seriously, then the authors of that rhetoric need to understand that higher reliability is, in the middle term, more expensive. It will help if our political leaders remember that in the long run it would have cost less to have operated the Three Mile Island nuclear facility reliably, than it has cost to clean it.

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